THE

Malayan Agricultural Journal.

Vol. XII. March, 1924. No. 3.

OBITUARY.

The Late Inche Ahmat bin Johar.

BY the death on January 31st, 1924 of Inche Ahmat bin Johar, the Department of Agriculture has lost a valuable officer, and the entire staff in expressing genuine and sincere sympathy to his sorrowing wife and relations deeply regret his untimely end.

Inche Ahmat was educated at the Malay College, Kuala Kangsar, and joined the Department of Agriculture on 20th May 1913. He was attached to the Inspection Division for training and was stationed successively at Kuala Lumpur, Taiping and Kuala Kubu until he was transferred to the Botanical Division on 1st July 1922.

He was promoted to the grade of Junior Agricultural Assistant on 1st July 1919 and was recommended for promotion as Senior Agricultural Assistant as a result of the examination in September 1923 in which he acquitted himself brilliantly, taking first place well ahead of all the other competitors.

Inche Ahmat was an intelligent and promising officer anxious to acquire agricultural knowledge and a keen student. He was interested in his work and aimed at benefitting his fellow-countrymen.

Temperamentally, he was modest, nervous and highly strung; he endeared himself to his fellow officers by his ability, thoughtfulness and refinement, and his loss is deeply regretted.

MISTLETOES ATTACKING CULTIVATED TREES IN MALAYA.

By W. N. Sands.

AMONG the common pests of cultivated dicotyledonous trees in Malaya are several species of mistletoe. These are semi-parasitic flowering plants, all belonging to the Natural Order, *Loranthaceae*. According to Gamble[1] some forty-five species are known to occur locally, but a few only attack rubber, fruit and shade trees to any extent, and these belong to the three genera, *Loranthus*, *Elytranthe* and *Viscum*.

The Malays have several terms for the parasites which are all forms of the Malay word, Dědalu, meaning mistletoe; for example, Nĕnalu (Kedah), Dalu and Dĕndalu (Province Wellesley), Bĕndalu (Riau-Johore), Gĕnalu (Trengganu), also Bĕnalu, Bindalu, Mĕnalu and Kĕmĕndalu. Further some of the commoner species are given descriptive specific names such as Dědalu api (fire), D. gajah (elephant), D. besar (large), D. asap (smoke).

In 1911 Bateson[2] recorded the occurrence of a species of *Loranthus* on rubber (*Hevea brasiliensis*) in Pahang, whilst in 1914, Brooks[3,4] gave an account of two species of *Loranthus*, which he did not name, attacking rubber on a few estates in Negri Sembilan and mentions that one of these was also found growing on a common melastomaceous plant, presumably Kedudok (*Melastoma malabathricum, Linn*). Since then reports of mistletoe infesting rubber and other trees have been received from various places.

During the past few months an effort has been made, with the co-operation of Officers of the Inspection Division of the Department of Agriculture and others, to obtain information regarding the species damaging cultivated trees in different parts of the Peninsula. The results of this preliminary investigation are now given.

Biology and Life History.

To those who are not familiar with these plant pests, a short account of the biology and life-history of them may perhaps be usefully included here. Mistletoes are mostly green-leaved, evergreen shrubby plants specially adapted for growing on dicotyledonous trees, *e.g.*, Rubber, Rambutan and Pomelo; they are not able to thrive on monocotyledonous trees such as Palms and Bamboos. They are parasitic because they withdraw from the internal tissues of their hosts, water and essential inorganic nutrient materials such as an ordinary terrestial plant obtains directly from the soil. They are not completely parasitic because they possess green leaves, or in the case of *Viscum articulatum*, flattened branches which contain the green colouring matter-chlorophyll in their cells and are therefore able to convert water and carbon-dioxide into organic food materials, namely

carbohydrates, by means of the energy derived from light. This phenomenon is known botanically as photosynthesis. Owing to this faculty of acquiring organic nutritive substances, the parasites do not as a rule destroy their hosts rapidly unless these are in poor condition and the infestation is a heavy one. In this respect mistletoes differ from certain of the lower and well-known fungus parasites which rely entirely on the organic food-stuffs already formed by green-leaved plants, and which often kill rubber and other trees fairly quickly.

The leaves of the local species of mistletoe vary considerably in size; those of *Loranthus grandifrons, King*, measure up to 10 inches long and 5½ inches broad, whilst those of *Viscum articulatum, Burm*, are reduced to minute scales. They are usually leathery and modified to limit the transpiration of water and conserve it during periods of the year when rainfall is deficient. At these times the hosts, and consequently the parasites, are unable to obtain a full supply of water; also during the "wintering" period of deciduous hosts the mistletoes would suffer unless their leaves were adapted to prevent the rapid loss of water.

Flowers are produced in abundance in the species under consideration and they also differ greatly in character, size and colour. In the genera *Loranthus* and *Elytranthe* they are hermaphrodite, that is both stamens and pistil occur in the same flower, whereas in *Viscum* the flowers are unisexual. The flowers of the former are adapted for pollination by insects whilst it is probable that those of the latter, although so small, are insect pollinated. Observations on *Loranthus ferrugineus* point to the fact that the flowers of this and other species are also pollinated by the beautiful little sun-birds of the group—Nectariniidae—as these have frequently been seen inserting their beaks in the flowers in search of food. In this connexion Keeble[5] states that the tube-flowered species of *Loranthus* of Ceylon are pollinated by a common honey-sucker which is also a species of Nectarinia, and that the bird was always to be found in the early morning visiting the flowers.

In *Loranthus grandifrons* the flowers are 3 inches long and rosy pink in colour; those of *Elytranthe globosa* are about ½ inch long and coloured greenish yellow, whereas those of *Viscum articulatum* are scarcely visible.

The fruits are one-seeded succulent berries, usually brightly coloured or white, with a fleshy exterior and often mucilaginous interior. The seed has a very sticky gelatinous coat which enables it to adhere closely to any surface with which it comes in contact. This gelatinous covering is able to absorb water from rain, mist or dew with the result that the seed is prevented from perishing; and further, it is the only means by which the seed on germination obtains the necessary water for growth until the haustorium or sucker has penetrated into the water-bearing tissues of the host.

It is practically certain that birds which feed on the berries are the chief means by which the seed is disseminated locally. The Malays state that birds are very fond of the berries, at any rate, these

have been seen frequently in considerable numbers in the bushy clumps of fruiting mistletoes. When *Loranthus ferrugineus*, *L. pentandrus*, and *Elytranthe Barnesii* are in full fruit, fruit-skins and occasionally discarded seed can usually be found beneath trees infested with these parasites, but investigations along this line with other indigenous species are incomplete. Observations in other countries have shown that birds after feeding on the pulp of the berries wipe their beaks against the branches of trees in order to clean them of the sticky seed which is distasteful to them; also they may void any seed swallowed on to branches in their excrement. Other possible agencies for dispersal are heavy rain which beats down the fruit; high winds and the natural fall of ripe berries from higher to lower levels of the host trees.

The seed on germination puts out a short stout cylindrical root-like body, the hypocotyl, which swells out at its free end into a disc on coming in contact with the bark of its host and forms what is known as a holdfast. From the central and lower portion of this the haustorium, or sucker, developes, which body is capable of penetrating to a considerable depth into the tissues of the host by means of solvent ferments and the pressure resulting from growth. When the source of water and food has been made secure by the haustorium the young shoot developes rapidly.

Humid conditions are essential for the successful germination of the seed.

The haustorium in forcing its way through the bark destroys this along its passage and eventually penetrates the wood and forms a close connection between the wood-vessels of the host and those of the parasite, so that water and raw food materials can be readily obtained.

As growth proceeds a rounded swollen mass of tissue forms over the place where the holdfast was attached to the host tree. The swellings may be large or small. In *Loranthus pentandrus* they are very large. In old specimens they are often as large as a tennis ball and completely surround the branch, with additional large hypertrophied masses at points where the haustoria of secondary roots attach themselves to branches and twigs. (Plate ii Fig 4 A.B.). In the other local species under consideration the swellings, although present, are not as prominent. In all species of *Loranthus* and *Elytranthe* secondary branches arise at the original point of infection, also secondary branching roots which travel for considerable distances along and around the infested branch in different directions. At frequent intervals, $\frac{1}{4}$ inch on twigs to $1\frac{1}{2}$ inch, or more, on larger branches, haustoria are formed along the side of the root-runner nearest the branch and enter it. (Plate ii Fig 4 (c)). From the upper side of the runner shoots arise which form thick bushy plants like the parent parasite. In this way a tree may become heavily infested from a single seed.

The two species of *Viscum*, namely, *Viscum orientale* and *V. articulatum* do not reproduce themselves by means of surface root-runners, but the original haustorium throws out short lateral out-

growths under the soft bark or cortex of the host which spread along and around it and develope further suckers which penetrate the wood. A certain amount of thickening takes place about the first point of contact with the host and large single masses of growth develope from it. (Plate i Fig 2.)

The haustoria continue to expand and multiply as growth proceeds. Eventually, the end of the branch of the host is killed as a result of the withdrawal by the parasite of all the water and inorganic food materials obtained from the soil and the destruction of the cambium, phloem and other bark tissues. In cases where the parasitism is heavy the whole tree may be so weakened that it dies. Many examples of useful trees which had been irretrievably damaged, or killed, by mistletoes were noted during the course of investigations in different parts of the Peninsula.

The original infestations of cultivated trees by mistletoes on estates, in kampongs, and on shade trees planted along roadsides were due, no doubt, to birds bringing the seed from neighbouring jungle or wayside trees which are known to support the species described below. Generally speaking, the parasites are found on the higher and outer branches of the trees they attack, that is, in places where they can obtain plenty of light. They do not, as a rule, thrive under dense shade, hence cultivated trees that are in poor condition may suffer more severely than those in good health ; but there are four common species which have been observed to grow and fruit well even under fairly densely shaded conditions during the greater part of each day, these are *Loranthus ferrugineus, L. pentandrus, L. grandifrons* and *Elytranthe globosa*. None of these species, as will be shown later, is very particular in its choice of host trees.

It is of interest to note that certain of the local species can parasitize each other, for example, *Loranthus ferrugineus* has been found growing on *L. pentandrus, Elyranthe globosa, E. Barnesii* and *Viscum articulatum*, whilst *Viscum articulatum* has been freqeuently observed on *Loranthus pentandrus, L. ferrugineus, Elytranthe globosa* and *E. Barnesii,* (Fig 5. Plate iii) but the most unusual case of hyperparasitism was noted on a Durian (*Durio zibethinus*) tree which was attacked by *Elytranthe Barnesii.* On this mistletoe was growing *Viscum articulatum*, and on *V. articulatum, Loranthus ferrugineus.* (Plate iii Fig 6.)

In this connexion it may be mentioned that to-date *Viscum articulatum* has only be found by the writer on other species of mistletoe, still at Rembau in Negri Sembilan it was recorded as growing on the Mangosteen (Garcinia Mangostana) and the Rambutan (Nephelium lappaceum), and in Penang on the Chenderai (*Grewia paniculata*) and Bodi (*Ficus religiosa*), and no doubt occurs as a direct parasite elsewhere.

The commonest species are *Loranthus ferrugineus, L. pentandrus* and *Elytranthe globosa*; these have been collected in all districts. Less common, but widely distributed, are *Loranthus grandifrons, L. pentapetalus, Viscum orientale* and *V. articulatum*, whilst

Elytranthe platyphylla and *E. Barnesii* have been collected once only, but the latter may have been overlooked as it resembles *E. globosa* when seen growing at a height on host trees on account of its swollen nodes and opposite leaves.

Description of Species.

The following is a brief description of each of the five most important species from the point of view of the injury done by them to cultivated trees. The descriptions, although derived chiefly from those given by Gamble[1], are supplemented by notes on the living plants and their hosts.

The two species *Elytranthe Barnesii* and *E. platyphylla* are of minor importance and need not be described here. As mentioned previously each has been collected once only, the former on the Durian (*Durio zibethinus*) and the latter on the Chempedak (*Artocarpus Polyphema*).

Although *Viscum orientale* has been found in great abundance on certain trees planted along roadsides, namely *Ficus indica*, *F.Benjamina* and *Albizzia moluccana*, it has not been collected on rubber or fruit trees. This species is readily recognized as it resembles in growth and foliage the well-known European mistletoe (*Viscum album*). Its berries, however, are red. The other species which is not described in detail, namely *Viscum articulatum*, is referred to above, and as there stated, appears to be mainly parasitic on oher species of mistletoe.

1. *Loranthus ferrugineus, Roxb.* (Plate 1 Fig 1.)

This is a much branched, bushy, wiry shrub with pendulous branches and long thin surface root runners. Small swollen masses of tissue occur at points where haustoria enter host. Bark brown, minutely lenticellate, uppermost parts like the under surface of the leaves and the inflorescence, covered with dense rusty matted short hairs. Leaves opposite or sub-opposite; leathery, usually uniform in shape on single plants, ovate to elliptic with a broad apex and rounded base ; petiole short ; about 3/10 inch long. Flowers clustered in the axils of the leaves and borne on short few-flowered inflorescences. Calyx tube short, densely hairy. Corolla $\frac{1}{2}$ inch to $\frac{3}{4}$ inch long, rusty hairy on the outside and smooth within; club-shaped in bud, when open cleft on one side half way down and dividing into 4 lobes slightly incurved at summit. Stamens 4, anthers oblong, filaments broad, dark red. Ovary cylindric, style slender, dark red about 1/3 of its length, four-angled. Fruit a pear-shaped berry covered with dense rusty short hairs, becoming slightly paler in colour when ripe.

This plant is ubiquitous in lowland districts. It, however, rarely occurs on rubber (*Hevea brasiliensis*), although it grows on numerous native plants and most fruit trees. It is the only species so far found on the well known shade tree the Saman (*Pithecolobium Saman*). It has also been collected on Tapioca (*Manihot utilissima*) and the

common wayside plants the Kedudok (*Melastoma malabathricum*), and the Ara Perak (*Ficus alba*) as well as on certain species of mistletoe.

The following useful trees have been recorded as hosts of this species :—

Name.	Malay Name.	Botanical Name.
Avocado Pear	...	Persea gratissima, Gaertn.
Belimbing	Belimbing	Averrhoa Bilimbi, L.
Casuarina	Ru	Casuarina equisetifolia, L.
Gooseberry	Chamin-Chamin ; Chermai	Cicca acidissima, Blanco.
Governor plum	Kukum	Flacourtia cataphracta, Roxb.
Guava	Jambu biji ; J. belawas	Psidium Guajava, L.
Jack Fruit	Nangka	Artocarpus integrifolia, L.
Jering	Jering	Pithecolobium lobatum, Benth
Kapok	Kapok ; Kabu-Kabu	Ceiba pentandra, Gaertn.
Langsat	Langsat	Lansium domesticum, Jack.
Lime	Limau Asam	Citrus Medica var : acida.
Mango	Machang ; Bachang	Mangifera foetida, Lour.
Orange	Limau manis	Citrus Aurantium, L.
Pomegranate	Delima	Punica Granatum, L.
Pomelo	Limau abong ; L. besar	Citrus decumana, Murr.
Pulasan	Pulasan	Nephelium mutabile, Blume.
Rain Tree	Saman	Pithecolobium Saman, Benth.
Rambai	Rambai	Baccaurea Motleyana, Muell.
Rambutan	Rambutan	Nephelium lappaceum, L.
Rubber	Getah	Hevea brasiliensis, Muell.

2. *Loranthus pentandrus, Linn.*

A large, stoutly branched, bushy shrub. Large masses of hypertrophied tissue occur at points where primary and secondary haustoria enter host, these are rounded and become knobby and warty with age. Secondary roots stout. Bark grey to blackish grey; lenticles numerous, oval. Leaves thick, leathery, sub-opposite or alternate, dark green, variable in shape and size, lanceolate to ovate elliptic, obtuse to acute at apex, tapering to cuneate at base, both surfaces glabrous, mid-rib stout prominent below, petiole stout under ½ inch long. Flowers in axillary, often clustered, short racemes which are grey-pubescent, as are the calyx, corolla and filaments of the stamens. Calyx tube ovoid, or pitcher-shaped, with limb shortly 5-toothed. Corolla in bud 7/8 inch to 1 inch long, cylindric above and inflated below; when open cleft to middle two-thirds of way down into five equal linear acute lobes which are reflexed at their middle, greenish outside and yellowish within. Stamens 5, erect, nearly as long as corolla lobes,

anthers linear. Ovary ovoid, style rather thick, angled. Fruit ovoid, dark green even when ripe, contracted and surmounted by the persistent calyx limb, at first mealy afterwards becoming glabrous.

Like the previous species this is found in all districts and has a wide range of native and cultivated host trees among these being the roadside plant the Kedudok (*Melastoma malabathricum*). It is common on rubber (*Hevea brasiliensis*) in some districts and often damages this tree severely.

Its hosts among cultivated trees are :—

Name.	Malay Name.	Botanical Name.
Belimbing	Belimbing	Averrhoa Bilimbi, L.
Cashew Nut	Janggus	Anacardium occidentale, L.
Chempedak	Chempedak	Artocarpus Polyphema, Pers.
Circassian Seed	Saga	Adenanthera pavonina, L.
Croton	Puding	Codiaeum variegatum, Blume.
Duku	Duku	Lansium domesticum, Jack var : Duku.
Durian	Durian	Durio zibethinus, Murr.
Gooseberry	Chamin-Chamin ; Chermai	Cicca acidissima, Blanco.
Guava	Jambu biji ; J. belawas	Psidium Guajava, L.
Jering	Jering	Pithecolobium lobatum, Benth
Kundangan	Kundangan	Bouea macrophylla, Griff.
Langsat	Langsat	Lansium domesticum, Jack.
Lime	Limau asam	Citrus Medica var : acida, L.
Mango	Machang ; Bachang	Mangifera foetida, Lour.
Mango	Mampelam ; Ampelam	Mangifera indica, L.
Mangosteen	Manggis	Garcinia Mangostana, L.
Orange	Limau manis	Citrus Aurantium, L.
Pomelo	Limau abong ; L. besar	Citrus decumana, Murr.
Rambai	Rambai	Baccaurea Motleyana, Muell.
Rose Apple	Jambu ayer	Eugenia aquea, Burm.
Rose Apple	Jambu ayer mawar	Eugenia Jambos, L.
Rubber	Getah	Hevea brasiliensis, Muell.
Sapodilla	Chiku	Achras Sapota, L.
Silk Cotton	Kapok ; Kabu-Kabu	Ceiba pentandra, Gaertn.
Teak	Jati	Tectona grandis, L.

3. *Loranthus grandifrons, King.*

A large shrubby plant, branches stout with dark greyish brown bark. Lenticels rounded; branchlets slender, slightly swollen at nodes and dark brown; very young shoots and leaves covered with short felted grey hairs. Swollen masses of tissue not large at places where haustoria enter host. Surface root-runners long, fairly stout with rough bark. Leaves large, alternate, or sub-opposite, rarely opposite, leathery, broadly ovate or lanceolate, acute or acuminate at apex, rounded or cordate at base, both surfaces dull and almost glabrous, margin recurved, 5 to 10 inches long and 2½ to 5½ inches broad; mid-rib stout, very prominent below, main nerves curving upwards and joining near margin, petiole thick ½ inch to 1 inch long. Flowers on stout racemes from the axils of the leaves, or fallen leaves; racemes 2 to 4 inches long, densely covered with short felted grey hairs, erect or curved. Flowers 20-30; pedicels short, thick. Calyx tube short, cylindric, inflated at base, limb 5-6 toothed. Corolla tube long, slender, broadening upwards, base whitish, upper parts pink, 2½ to 3 inches long, slightly curved, lobes 5, reflexed, red within. Stamens 5, anthers linear, flattened, filaments hairy. Ovary ovoid, style slender slightly longer than stamens. Fruit ovoid, covered with short thick grey hairs, about ½ inch long, surmounted by the persistent calyx.

This species is widely distributed and fairly common in certain districts. Among its hosts are :—

Name.	Malay Name.	Botanical Name.
Silk Cotton -	Kapok, Kabu-Kabu -	Ceiba pentandra, Gaertn.
Mango -	Machang, Bachang -	Mangifera foetida, Blume.
Lime -	Liman asam -	Citrus Medica var: acida, L.
Pomelo -	Liman abong; L. besar -	Citrus decumana, Murr.
Rose Apple -	Jambu ayer mawar	Eugenia Jambos, L.
Rambutan -	Rambutan -	Nephelium lappaceum, L.

4. *Loranthus pentapetalus, Roxb.*

A much branched shrub, forming large masses of erect and pendulous branches. Bark brown to blackish brown, or grey on young seedlings, rather rough. Secondary roots long and fairly thick. Hypertrophied masses of tissue where haustoria enter host, not prominent. Leaves bright green, glabrous, leathery, opposite or sometimes alternate, somewhat variable in shape, but chiefly ovate-lanceolate, acute or acuminate at apex and tapering to base, $2\frac{1}{2}$ to $4\frac{1}{2}$ inches long and 1 to $1\frac{1}{2}$ inches broad. Mid-rib prominent beneath, nerves faint, petiole $\frac{1}{4}$ to $\frac{1}{2}$ inch long. Racemes solitary, or in twos or threes, from the axils of the leaves or fallen leaves, about 4 inches long, all parts bright red except tips of petals which are yellow. Flowers numerous on short thick pedicels; in bud all set parallel to the main axis of the inflorescence and constricted at the middle. Calyx cylindric, minute, limb obscurely toothed. Petals 5, the basal portion obovate, thick, glabrous and convex within; the neck transversely wrinkled, the upper portion strap-shaped, pointed, reflexed in flower, the whole about 2/5 inch long only. Stamens 5, inserted above the neck of petals. Ovary shortly cylindric, style jointed at middle. Fruit crimson, ellipsoid, shortened at end about $\frac{1}{4}$ inch long.

This is a widely distributed species, fairly common in some localities on native trees. It has been collected so far on two cultivated trees only, but without doubt occurs on others.

Name.	Malay Name.	Botanical Name.
Rambutan -	Rambutan -	Nephelium lappaceum, L.
Rambai -	Rambai -	Baccaurea Motleyana, Muell.

5. *Elytranthe globosa, G. Don.* (Plate 2 Fig. 3).

A thickly branched glabrous shrub. Bark brown to light brown on branchlets; lenticels numerous, oval, nodes swollen. Primary and secondary swellings where haustoria enter host, small or absent. Secondary roots robust, long, with numerous branches. Leaves leathery, dark green, mostly opposite, elliptic-ovate or ovate lanceolate, acuminate at apex and sloping to base, both surfaces smooth, shining, 3—$4\frac{1}{2}$ inches long and $1\frac{1}{4}$ to $2\frac{1}{4}$ inches broad; mid-rib prominent, nerves inconspicuous; petiole short about $\frac{1}{4}$ inch long. Flowers in small axillary racemes, single, or in pairs, or clustered, $\frac{1}{2}$ inch long, 2 to 5 flowered, pedicels short, slender. Calyx tube pitcher-shaped, limb cup-like. Corolla in bud, narrow, thickened towards the apex

with folds below nodes, when open campanulate; lobes 6, sometimes 5, reflexed at middle, narrow, green to yellow usually with purplish tips and stripes. Stamens as many as lobes; style long; stigma large, capitate. Fruit an ovoid or globose yellowish berry, $\frac{1}{4}$ inch long.

This is a common species which is frequently found on rubber (*Hevea brasiliensis*) as well as numerous other useful trees. It has been recorded as growing on: —

Name.	Malay Name.	Botanical Name.
Belimbing	Belimbing	Averrhoa Bilimbi, L.
Cashew Nut	Janggus	Anacardium occidentale, L.
Chempedak	Chempedak	Artocarpus Polyphema, Pers.
Carambola	Belimbing batu	Averrhoa Carambola, Adans.
Casuarina	Ru	Casuarina equisetifolia, L.
Guava	Jambu biji	Psidium Guajava, L.
Jack Fruit	Nangka	Artocarpus integrifolia, L.
Mangosteen	Manggis	Garcinia Mangostana, L.
Rambai	Rambai	Baccaurea Motleyana, Muell.
Rambutan	Rambutan	Nephelium lappaceum, L.
Rubber	Getah	Hevea brasiliensis, Muell.
Sapodilla	Cheku	Achras Sapota, L.
Sentol	Sentol	Sandoricum indicum, Cav.
Silk Cotton	Kapok; Kabu-Kabu	Ceiba pentandra, Muell.

Control of Mistletoes.

It has been mentioned that mistletoes reproduce themselves by means of succulent berries containing sticky seed which are dispersed

chiefly by birds, therefore it is important that the parasites be recognized and exterminated at an early stage of growth. If the berries are allowed to ripen the pests will quickly spread to new host trees. Where the centres of infection are jungle, or wayside trees, some difficulty may be experienced in preventing infections of plantations and orchards but much may be done by frequent inspection and early treatment to prevent seedlings of the parasites establishing themselves and causing material damage. Further it has been shown that the commonest local species of *Loranthus* and *Elytranthe* readily reproduce themselves on individual trees by means of long surface 'runners', so that this is another reason why the parasites should be removed before they become firmly established and cause extensive damage.

To remove mistletoes effectively the smaller branches of infested trees should be pruned back 3 to 4 inches below the points of attack: this in the case of the species with long 'runners' would imply removal below any point where the haustoria had entered a branch. To prune, or pull off, the mistletoes is of little value as new shoots quickly develope from the haustoria embedded in the tissues of the branches.

With reference to the question whether the parasites can be removed from large branches or stems without fatal injury to the host trees, it may be of interest to mention that Bray [6] states that in the case of the American mistletoe (*Phoradendron flavescens*) that plants of this were shaved off close to the bark and painted with carbolineum with the result that after 14 months no fresh growth appeared, also that his experiments seemed to indicate that a strong preservative such as wood-creosote, or carbolineum, could be applied in sufficient quantity to kill the mistletoe without seriously injuring the branch or trunk. Whilst this method may be useful in the case of a valuable fruit tree when it is desired to retain a particular branch, or branches, yet it would appear to be of doubtful value, for example on a rubber plantation where judicious pruning in the manner described above is the treatment indicated. However, when a tree has become very heavily infested and weakened, it may be questioned whether any method of dealing with the parasite, or parasites, would eventually lead to the restoration of the tree's former vigour and usefulness.

Summary.

1. Mistletoes are shown to be common, and often serious pests of cultivated trees in Malaya. The destructive species belong to the genera *Loranthus*, *Elytranthe* and *Viscum*.

2. A short account of the biology and life history of the parasites is included. It is pointed out that the pests are dispersed chiefly by birds which feed on the succulent berries, and further that the species of *Loranthus* and *Elytranthe* described, readily reproduce

themselves vegetatively on individual trees by means of long surface root-runners.

3. It shown that certain species readily parasitize each other.

4. Descriptions of the five chief pests of cultivated trees, namely *Loranthus ferrugineus*, *L. pentandrus*, *L. grandifrons*, *L. pentapetalus* and *Elytranthe globosa* are given, together with a list of names of the trees on which each species has been found. Notes are also included on two other species of *Elytranthe* and two species of *Viscum* which are of less importance.

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Plates.

Plate 1, Fig. 1 - *Loranthus ferrugineus, Roxb,* at right on a wayside tree the Ara Perak. (*Ficus alba, Reinw.*)

„ Fig. 2 - *Viscum orientale, Wild,* on a branch of Albizzia moluccana, Miq. Note absence of secondary surface root-runners.

Plate 2, Fig. 3 - *Elytranthe globosa, G. Don.* growing on rubber (*Hevea brasiliensis, Muell.*)

„ Fig. 4 - The chief species attacking rubber (*Hevea brasiliensis Muell*),

(A) Young plant of *Loranthus pentandrus, L.* with leaves removed.

(B) A secondary root-runner of *L. pentandrus* with shoots, (leaves removed). Note the large masses of hypertrophied tissue where haustoria enter host.

(C) Secondary roots and shoots (leaves removed) of *Elytranthe globosa, G. Don.* Places where haustoria enter branch of host are only slightly swollen.

Plate 3, Fig. 5 - Hyperparasitism. (A) Branch of *Elytranthe Barnesii, Gamble.* with (B) a young plant of *Loranthus ferrugineus, Roxb.* and (C) (C) two small plants of *Viscum articulatum, Burm.*

„ Fig. 6 - Hyper-parasitism—(A) Branch of *Elytranthe Barnesii, Gamble.* on which is growing (B) *Viscum articulatum, Burm.* and on the latter is (C) a strong plant of *Loranthus ferrugineus, Roxb.*

Fig. I.

Fig. II.

Fig. III

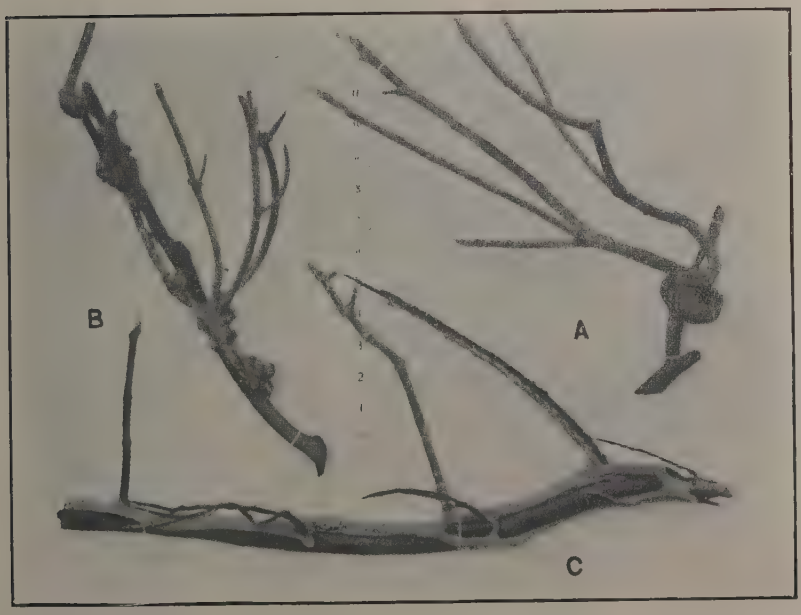

Fig. IV.

ILLIPE NUTS AND BORNEO TALLOW.

By C. D. V. Georgi.

DURING the past two years several samples of the fat expressed from Illipe nuts have been examined, and it has been thought that it might be useful to record the results of the investigations, especially in view of the confusion which exists as to the name Illipe and the uncertainty regarding the botanical name of the trees from which the nuts are obtained.

The confusion regarding the name Illipe is due to the fact that this name is applied to two distinct nuts, the true Illipe nut of India, a species of *Bassia* (Natural Order, Sapotaceae) and the so-called Illipe nuts found in this country, Borneo, Sumatra and Java, derived from various species, principally *Shorea* (Natural Order, Dipterocarpeae). There is however one kind of local Illipe nut, prefixed by the name Siak, which belongs to the same Natural Order as the true Illipe nut of India, but is a different species, namely *Palaquium*.

The uncertainty regarding the botanical names for the trees, from which the nuts are obtained, arises from the fact that these trees are scattered over wide areas of jungle. The collection of the nuts is a native industry, and in many cases it has not therefore been possible to establish the identity of the various trees. There are at present no plantations of these trees and it does not appear likely that any attempts will be made in this direction, as the trees take several years to come into bearing and the yield is variable.

The fat expressed from these local Illipe nuts is known commercially as Borneo tallow, this name being derived doubtless from the original country from which the fat was obtained, and from the resemblance which the fat itself bears to tallow as regards consistency.

The fat is known by the Malays as Minyak Tengkawang, variations of the latter name such as Tinkawan, Tengkawan and Sengkawang being also found.

Harvesting of Fruits.

As stated above, the cultivation of various trees yielding these nuts has never been undertaken systematically, so that there is practically no information available as to growth and period of maturity. As far as is known the trees do not commence bearing fruit until 10 or 12 years old, and the yield is uncertain. The trees flower towards the end of the dry season, August-September, and the fruits are ready for gathering during February-March of the following year. The fruiting appears to be dependent on the weather prevailing at the time of flowering; if the flowers set well before the advent of the wet season there is every chance of a good crop but, if the flowering coincides with the break in the weather, the crop will suffer.

The fruits fall when ripe and and are collected by the natives who shell them; only the kernels are exported and constitute the so-called Illipe nuts of commerce.

The shell of the nut is somewhat tough and the natives resort to various methods to facilitate its removal. In some cases the fruits are packed into a bamboo basket or cage and sunk in a river or stream

for a few weeks. In this way the shell becomes soft and can be removed easily, after which the kernels are dried.

Another method which would appear to be favoured by the natives is to heap the nuts in a damp place and allow them to germinate. The shells are then removed and the kernels dried. Frequently portions of sprouts are found with the kernels indicating that this method of separation has been employed.

Export of Nuts.

Little Borneo tallow is produced locally, the nuts being exported and expressed in Europe. A large proportion of the Illipe nut trade passes through Singapore; the figures in the following table compiled from the returns published by the Registrar of Imports and Exports Straits Settlements are of interest in this respect.

Imports.

Year.	Quantity (piculs).	Value $	Remarks.
1921	16,365	80,319	
1922	15,115	104,409	647 piculs from British Possessions and Protectorates, 14,468 piculs from other countries.
1923 (½ year)	222,037	2,341,413	118,079 piculs from British Possessions and Protectorates, 103,958 piculs from other countries.

Exports.

Year.	Quantity (piculs).	Value ($)	Remarks.
1921	7,561	39,496	
1922	30,125	258,616	4276 piculs to United Kingdom, 25,750 piculs to Continent of Europe, 99 piculs to other countries.
1923 (½ year)	146,033	1,873,379	43,742 piculs to United Kingdom, 102,253 piculs to Continent of Europe, 28 piculs to other countries.

Varieties of Nuts Examined.

In general the kernels yielding the so-called Borneo tallow of commerce are placed on the market as Illipe nuts, to which is prefixed the name of a district or town in Borneo e.g. Pontianak. In addition to this prefix the nuts are distinguished by their colour, black or brown and sometimes by their size, large or small, thus there are large brown Pontianak Illipe nuts and small Pontianak Illipe nuts. The difference in colour appears to be due to the treatment which the nuts undergo when being prepared for the market, though it is stated that those which are black in colour are the nuts which have remained on the damp ground or in jungle streams for some time before collection and have blackened naturally.

Messrs. Paterson Simons & Co. Ltd., who are the principal dealers in these nuts in Singapore, have furnished this Department very kindly with samples of the following varieties under their trade names, all of which samples have been examined :

Large Sarawak Illipe Nuts.

Small Sarawak Illipe Nuts.

Large Siak Illipe Nuts.

Small Siak Illipe Nuts.

Large Black Pontianak Illipe Nuts.

Large Brown Pontianak Illipe Nuts.

Small Pontianak Illipe Nuts.

In addition authentic specimens from one of the *Shorea* species, *Shorea Thiseltoni*, were obtained through the kindness of Dr. F. W. Foxworthy, Forest Research Officer, F.M.S., who also furnished a sample of the fat expressed from another species, *Isoptera borneensis*. These samples were also examined.

Description of Nuts.

(1) *Large Sarawak Illipe Nuts.*—These consisted of the segments into which the kernels separate on drying. The segments were approximately triangular in cross-section, dark brown in colour and curved longitudinally. They varied somewhat as regards length, being between 1.5 ins. and 2 ins. long.

(2) *Small Sarawak Illipe Nuts.*—These consisted almost entirely of whole nuts, though in some cases the latter had split up into segments. The nuts were dark brown in colour, pointed at one end and curved longitudinally. There appeared to be little variation as regards size, the average length being approximately $\frac{3}{4}$ inch.

(3) *Large Siak Illipe Nuts.*—These consisted partly of whole nuts and partly of half nuts, as distinct from the segments into which the Sarawak nuts were divided. In some cases the kernels were covered with a thin light brown skin. The kernels themselves were dark brown in colour and flat in shape, the dimensions varied slightly, the average being about $1\frac{1}{4}$—$1\frac{1}{2}$ ins. long and $\frac{1}{2}$ inch in breath.

(4) *Small Siak Illipe Nuts.* These consisted almost entirely of whole nuts, though a few were in halves similar to the large ones. As in the case of the large nuts some of the kernels were covered with a thin brown skin. The kernels were egg-shaped and dark brown in colour. The dimensions varied slightly, the average being about $\frac{3}{4}$ inch long and rather less than $\frac{1}{2}$ inch in breadth.

(5) *Large Black Pontianak Illipe Nuts.*—These were similar to the large Sarawak, except that the colour was darker and the segments were curved to a greater extent.

(6) *Large Brown Pontianak Illipe Nuts.* These again were similar to the large Sarawak except that they were of lighter colour and the dimensions of the segments were smaller, the average length being only slightly over 1 inch.

(7) *Small Pontianak Illipe Nuts.*—These were similar in size and colour to the small Sarawak Nuts.

(8) *Shorea Thiseltoni Nuts.*—The nut consisted of a thin fibrous brownish yellow shell enclosing a soft light green kernel. In some cases portions of the winged calices still remained attached to the nuts. The kernels were pointed at one end and were slightly under 1 inch in length and about $\frac{3}{8}$ inch in breath.

Examination of Fats.

In order to obtain a sufficient quantity of the fat for the determination of the physical and chemical constants, the kernels were picked over carefully to remove pieces of broken shell and other debris, and then crushed between rollers to a fine state of division. The sample for the determination of the fat content was withdrawn, and the remainder pressed hot in a small laboratory hand press.

The colours of the fats thus expressed varied only slightly, from a pale yellow to yellowish green, the fats from the Siak varieties were however almost white. It may be mentioned that the colours of these fats fade on exposure to light, so that after a short time the differences in colour between the Siak and other varieties would be still less marked. It was also noticed that although the fats could all be classed as of a firm consistency, those derived from the Sarawak and Pontianak varieties of nuts were harder than those from the Siak, All the samples possessed a faint odour resembling that of Cacao butter.

The results of analysis are shown in table A :

TABLE A.—Table showing the results of analysis of various kinds of Illipe Nuts.

Kind of Nuts.	Large Sarawak.	Small Sarawak.	Large Siak.	Small Siak.	Large Black Pontianak.	Large Brown Pontianak.	Small Pontianak.	Shorea Thiseltoni.	Isoptera borneensis.
Analysis of Nut (parts per cent).									
Moisture	6.4	8.0	7.1	5.7	6.3	6.3	7.3	34.8	...
Fat	50.9	41.8	47.7	55.8	59.1	48.4	42.4	19.5	...
Residue (by difference)	42.7	50.2	45.2	38.5	34.6	45.3	50.3	45.7	...
Constants. Fat.									
Melting Point	...	...	...	...	...	...	...	37—38°C	37—38°C
Density at 100°C (water at 15.5°C = 1)	...	...	...	...	...	...	...	0.857	0.861
Saponification value[1]	192.5	191.7	189.4	181.6	191.6	193.0	192.2	192.2	191.7
Acidity (Stearic acid per cent) ...	10.3	6.4	15.2	18.6	13.1	5.0	8.1	1.0	1.0
Unsaponifiable (per cent) ...	0.6	0.9	1.0	6.4	0.8	0.7	0.7	1.1	...
Fatty Acids.									
Solidifying Point (Titer value) ...	55°C	55.1°C	58.1°C	57.4°C	53.3°C	52°C	52.7°C	51.5°C	48.9°C
Mean Molecular weight	280.0	286.5	288.4	302.0	282.9	282.6	283.8	285.8	297.1

[1] Milligrammes of potash for 1 grammes of fat.

With regard to the fat contents of the various samples of nuts it will be seen that there are considerable variations even among those samples which differ only in colour, as for example large black Pontianak and large brown Pontianak.

The constants of the fats, with the exception of the acidity figures, vary only within relatively narrow limits, except that the high percentage of unsaponifiable matter in the fat from the small Siak variety (this affects both the saponification value and the mean molecular weight of the fatty acids) is particularly noticeable.

The high acid values of the commercial samples are undoubtedly due to the manner in which the kernels are prepared for the market, though, if the nuts were left lying about for some time in the jungle before collection, fermentation would set in, which would also tend to increase the acidity of the fat. It will be noticed that in the case of the two samples supplied by the Forest Department, in which the nuts were collected carefully, the fat was almost neutral.

Uses of Borneo Tallow.

While small quantities of these fats are used by natives for edible purposes, particularly in cases where there are religious objections to the use of animal facts, the value of Borneo tallow lies in the application which it finds in Europe as an edible fat, especially in the preparation of chocolate for eating purposes. Borneo tallow closely resembles Cacao butter in its analytical constants and on this account can be employed as a substitute.

The following table illustrates the resemblance between these two facts, the figures for Cacao butter being taken from Lewkowitsch "Chemical Technology and Analysis of Oils, Fats and Waxes" Fourth Edition, Vol. II pages 480 and 481, those for Borneo tallow being taken from the table previously given.

		Cacao butter	Borneo tallow
Fat.			
Density at 100°C (water at 15.5°C = 1)	...	0.8577	0.861
Melting Point	...	28-33°C	37-38°C
Saponification value[1]	...	191.8-194.5	191.7
Iodine value	...	34.7-37	29.9
Fatty Acids.			
Solidifying Point (Titer value)	...	49.6°C	48.9°C

Smaller quantities of Borneo tallow are used in the manufacture of soaps and candles. Messrs. Paterson Simons & Co. state that the Sarawak and Pontianak varieties are used almost exclusively for edible purposes, whereas the Siak varieties are employed in soap-making.

Received for publication 31st December 1923.

[1] Milligrammes of potash for 1 gramme of fat.

LEMONGRASS OIL.

By C. D. V. Georgi.

LEMONGRASS, a grass similar in appearance to Citronella, is found distributed throughout Malaya, chiefly in small clumps in small holdings and kampongs, where the natives use it to a small extent for culinary purposes.

The grass contains as essential oil, lemongrass oil, for which there is a limited demand and a series of experiments has been carried out to determine the yield of oil from the grass and the value of the oil.

The supply of grass for the experiments was obtained from the Government Experimental Plantation, Serdang, where small areas of this crop are under cultivation.

In spite of the fact that there appears to be little demand for this oil at present, it is thought that the publication of the results of this investigation will be of interest.

Varieties of Grass.

Lemongrass belongs to the genus *Cymbopogon* (Natural order Gramineae) to which natural order other so-called aromatic grasses belong, notably citronella grass which, as is well known, is distilled for its essential oil.*

There are two varieties of lemongrass, known as *Cymbopogon flexuosus*, Stapf and *Cymbopogon citratus*, Stapf. The former variety produces the oil known as "East Indian Lemongrass Oil," which differs from that obtained from the *C. citratus*, Stapf in respect of solubility in 70 per cent. alcohol. The genuine "East Indian Lemongrass oil" is soluble in 1·5 to 3 vols. of 70 per cent. alcohol, while the oil from *C. citratus*, Stapf gives a turbid solution with this strength of alcohol.

The oil from *C. citratus*, Stapf, is referred to occasionally as "West Indian Lemongrass oil." This name was adopted before the botanical identity of the grass had been established, and was used to distinguish an oil which gave a turbid solution with 70 per cent. alcohol. Moreover at that time the greater proportion of such oil came from the West Indies.

The botanical origin of the local grass is somewhat doubtful, the oil giving a very slight turbidity with 70 per cent. alcohol. A sample of the oil has been judged by a firm of analytical chemists in London

*An article on the subject of Citronella oil entitled "The utilisation of citronella grass planted as a preventive of soil wash" was published in the Malayan Agricultural Journal Vol. XII, No. 1, Jan. 1924.

to be a genuine lemongrass oil of the "East Indian type" but from their report it appears that the solubility test was carried out with 80 per cent. alcohol, in which strength the oil was found to be soluble in the proportion of 1 : 1. The local grass is being identified botanically, and samples are being collected for despatch to the Royal Botanic Gardens, Kew, England.

Cultivation of Grass.

Lemongrass, like citronella requires a hot damp climate and flourishes in this country. If the grass is to be used for the preparation of oil it must be cut frequently, as the oil content diminishes with the age of the leaf. Further, like citronella, the oil output diminishes with the age of the plant, so that if the plant is cultivated on a commercial scale it will be necessary to replant the areas every few years.

Extraction of Oil.

The process by which the oil is extracted from the grass is similar to that described in the article under citronella grass,* that is, a steam distillation of the semi-dried grass.

The details of the process as regards the preliminary treatment of the grass, the steam distillation and the separation of the oil are the same as for citronella.

Yield of Oil.

As a result of the experiments carried out with the grass from Serdang it appears the average yield of oil is about 0.2 per cent. by weight, that is, 1 ton of fresh grass gives about 4 lbs. of oil. The weight of fresh grass per acre when cut regularly is between 4 and 5 tons per acre, so that a yield of 16– 20 lbs. of oil per acre per cutting is all that can be expected. Two or sometimes three cuttings a year can be made dependent on the season. If the grass is cut twice a year, this would result in an annual yield of 32—40 lbs. of oil per acre.

Value of Oil.

As a result of the experimental distillation about 6 lbs. of the oil was sent to the Malay States Information Agency, London for valuation.

The results of the chemical analysis as carried out by the firm of analytical chemists were as follows :—

Density at 15.5°C	...	0.902
Citral (Bisulphite process)	...	75/76 per cent.
Solubility in 80% alcohol	...	1 in 1 volume.

* Compare Malayan Agricultural Journal, Vol. XII, No. 1, Jan. 1924.

The oil was pronounced to be a sample of genuine lemongrass oil of the "East Indian type."

Unfortunately at that time (September 1923) the oil was in low demand the nominal value being about 2⅜d. per oz. spot, at which price there were no buyers. Recently (January 1924) there was a small advance to 2¾d. per oz. spot, at which price buyers began to come forward, but even at this price the production of the oil cannot be recommended as a commercial proposition.

Uses of Oil.

As its name implies, lemongrass oil has an intensive lemon-like odour and taste. The oil itself is a dark reddish brown liquid. Apart from the question of solubility in alcohol mentioned above, the characteristic feature of this oil is the citral content, which varies between 70 and 85 per cent. Citral is employed largely in artificial perfumery for the preparation of Ionone, the basis of artificial oil of violets. Smaller quantities of lemongrass oil are used in other perfumes, while in tropical countries this oil is employed as a mosquito preventive, but apart from its application in the preparation of the artificial violet perfume this oil is not of great importance.

Received for publication 31st January, 1924.

MARKETS FOR ESSENTIAL OILS.

TWO enquiries have been received recently from firms interested in essential oils, especially citronella oil and patchouli oil. Both of these products were formerly produced in Malaya from citronella grass and patchouli grown in the country. At the present time there is probably only one distillery for citronella oil in Malaya while the patchouli oil distillers are distilling leaves chiefly derived from the Netherlands East Indies (Sumatra) although an area has been planted in Johore.

Recently the price of citronella oil has risen considerably, the present market value being about 4/9 per lb for "Java" oil which is similar to the oil from the grass grown in Malaya.

The following notes on the packing of these oils have been supplied by one of the firms desirous of purchasing the oils.

Citronella Oil:—This oil can be shipped in iron or steel drums containing upwards of 5 cwt each and should be guaranteed pure and contain not less than 85 per cent of "Geraniol." (The "geraniol" figure indicates the content of the two principal constituents of the oil—geraniol and citronellal.)

Note:—Secondhand oil drums, after having been throughly steamed out, can be used for packing. Kerosene tins packed in crates can also be employed, but each tin would only contain about 35 lbs. of oil. Present price of Java oil 4/9 per lb.

Lemon Grass Oil:—This should be guaranteed pure and contain not less than 75 per cent of Citral. It can be packed in drums, as in the case of Citronella oil. At present however, prices are low owing to over production. Present price 2d. to 2 1/8d. per oz.

Patchouli Oil:—Shippers must be prepared to sell on C.I.F. or C. & F. terms either London or Continent and prices must include packages. Terms of payment C.O.D. after approval.

Notes.—All oils are tested by analytical chemists in London. Care should be taken in selection of containers and gross weight and tare indicated on the containers.

B. J. E. (11-1-24).

NOTES ON THE EXPERIMENTAL PLANTATION, SERDANG FOR THE MONTH OF FEBRUARY, 1924.

THE dry weather experienced during the month has been responsible for the ripening of a number of crops and the following plots were harvested :—Natal Red Top Grass (*Tricholaena rosea*), Dallis Grass (*Paspalum dilatatum*), Carpet Grass (*Axonopus compressus*) and Napier Grass (*Pennisetum purpureum*). With the exception of the first named, which contained too many weeds to be of any value, the wet weight of the grasses was recorded in each case.

Plots of Gingelly (*Sesamum indicum*), Arrowroot (*Maranta arundinacea*) and Roselle Fibre (*Hibiscus Sabdariffa* var. *altissima*) were also harvested. The last named plots were stripped by various methods in order to test which is the most economical.

A Hand/Power Macarthy Cotton Gin has been installed on the plantation and a quantity of the cotton harvested last season was ginned with very satisfactory results.

Considerable trouble has been experienced with night-flying beetles attacking various crops on the plantation, but these pests have been checked by spraying with a solution of Lead arsenate (2 lbs. of lead arsenate to 50 gallons of water) and also by digging the insects from around the collar of the plants.

Rain fell on 21 days during the month giving a total rainfall of 6.69 inches. The heaviest rainfall in 24 hours was 2.28 inches.

The maximum shade temperature recorded was 94°F and the minimum 66°F. The average maximum shade temperature was 90.48°F and the average minimum 69.76°F

Records of the cup-indicating anemometer show that the total run of the wind for the month was 1299.04 miles, the average run for the 12 hours from 6 a.m. to 6 p.m. being 35.16 miles and that from 6 p.m. to 6 a.m. 9.63 miles.

B.B. (10-3-24).

ECONOMIC AND NON-ECONOMIC PLANTING MATERIAL.

PRICE LIST.

Fruit Seedlings.

Avocado Pear, Persea gratissima.
Blimbing, Averrhoa Bilimbi.
Bullock's Heart, Anona reticulata.
Carambola, Averrhoa Carambola.
Chiku, Achras Sapota.
Durian, Durio zibethinus.
Guava, Psidium Guajava.
Jack fruit, Artocarpus integrifolia.
Jambu bol, Eugenia malaccensis. Red Malay apple.
Lemon, Citrus Medica var. Limonum.
Lime, Citrus acida.
Manggis hutan, Garcinia Hombroniana.
Mangosteen, Garcinia Mangostana.
Monkey Jack, Artocarpus rigida.
Orange, Citrus Aurantium.
Pomelo, Citrus decumana.
Rambai, Baccaurea Motleyana.
Rambutan, Nephelium lappaceum.
Soursop, Anona muricata.
Sugar-apple, Custard-apple, Anona squamosa.
Water Lemon, Passiflora laurifolia.

Numbers up to 100 seedlings	40 cents each.
Numbers up to 500 and more that 100	30 cents each.

Cover Crops.

Cassia mimosoides	seed	$1/- per lb.
Canavalia ensiformis	,,	30 cents per lb.
Centrosema Plumieri, Butterfly Pea	seed	8 cents per lb.
Clitoria canjanifolia,	,,	50 ,, ,, ,,
Crotalaria striata	,,	50 ,, ,, ,,
Crotalaria usaramoesis	,,	50 ,, ,, ,,
Dolichos Hosei, Sarawak Bean	cuttings	$1.50 per sack.
Leucaena glauca	seed	50 cents per lb.
Mikania scandens	cuttings	$1.50 per sack.
Mimosa invisa, Giant mimosa	seed	50 cents per lb.
Mucuna sp.	,,	50 ,, ,, ,,
Phaseolus lunatus, Lima Bean	,,	50 ,, ,, ,,
Tephrosia candida	,,	50 ,, ,, ,,
Tephrosia Hookeriana	,,	50 ,, ,, ,,
Tephrosia purpurea	,,	50 ,, ,, ,,

Grasses.

Australian Blue Couch, Digitaria didactyla,	$1.50 per bag of plants.
Bermuda, Cynodon Dactylon	$1.50 per bag of plants.

Carpet grass, Axonopus compressus	seed $1/- per lb.
Citronella, Andropogon Nardus	$2.50 per 1,000 plants.
Guinea grass, Panicum maximum	$2.50 „ 1,000 „
Lemon, Andropogon citratus	$2.50 „ 1,000 „
Love grass, Andropogon aciculatus	$1.50 per bag of plants.
Natal Red Top grass	$1.50 „ „ „ „
Paspalum dilatatum	$1.50 „ „ „ „

Seed, when available, 10 cents per oz.

European Vegetable Seeds.

Large seeded varieties e g., beans	20 cents per oz.
Others	40 „ „ „

Fibres.

Bimlipatam Jute, Hibiscus cannabinus	seed $1/- per lb.
Kapok, Eriodendron anfractuosum	seed 30 cents per lb.
Manila Hemp, Musa textilis	suckers 10 cents each.
Mauritius hemp, Furcraea gigantea	bulbils $1/- per 100.
Mauritius hemp, Furcraea gigantea	young plants $3 per 100.
Roselle, Hibiscus Sabdariffa var. altissima	seed $2 per lb.
Sisal Hemp, Agave rigida var. sisalana	bulbils $1 per 100.
Sisal Hemp, Agave rigida var. sisalana	young plants $3 per 100.

Miscellaneous Economic Plants.

Arrowroot	tubers 20 cents per lb.
African Oil Palm, Elaeis guineensis	seed $6 per 1,000
African Oil Palm, Elaeis guineensis	seedings $20 per 100.
Bixa Orellana	seed $1 per lb.
Castor Oil	seed 50 cents per lb
Coffee, Robusta and Liberian	seed 50 cents per lb
Coffee, Robusta and Liberian	plants $3 per 100.
Gingelly	seed 50 cents per lb.
Ipecacuanha, Psychotria Ipecacuanha	cuttings 10 cents each.
Ipecacuanha, Psychotria Ipecacuanha	young plants 40 cts. each.
Jerusalem artichoke, Helianthus tuberosus	tubers 20 cents per lb.
Maize	seed 20 cents per lb.
Patchouli, Pogostemon Patchouly	unrooted cuttings $2 per 100.
Patchouli, Pogostemon Patchouly	rooted cuttings $15 per 100.
Sweet potato, Ipomoea Batatas	cuttings $1 per 100.
Tobacco	seed $2 per oz.
Tuba Root, Derris elliptica	unrooted cuttings $2 per 100.
Tuba Root, Derris elliptica	rooted cuttings $15 per 100.

Non-economic Plants.

Flowering trees	seedlings 50 cents each.
Flowering trees	seed 10 cents a packet.
Shade trees	seedlings 50 cents each.
Shade trees	seed 10 cents a packet.
Shrubs	rooted cuttings 30 cents each.
Shrubs	unrooted cuttings 5 cents each.

Climbers	rooted cuttings 30 cents each.
Climbers	seed 10 cents a packet.
Showy annuals	seed 10 cents a packet.
Palms	seedlings 50 cents each.
Palms	seed 10 cents a packet.
Ferns	cuttings 25 cents each.
Bulbs	10 cents each.
Standards	50 cents each.

The above prices are quoted for material when available. Planting material of other agricultural or horticultural plants will be quoted, on application, when available.

Orders for planting material should be addressed to the Agriculturist, S.S. & F.M.S., Kuala Lumpur. A remittance to cover the amount should accompany the order.

Note :—The price list includes the cost of freight.

Received for publication 24th February 1924.